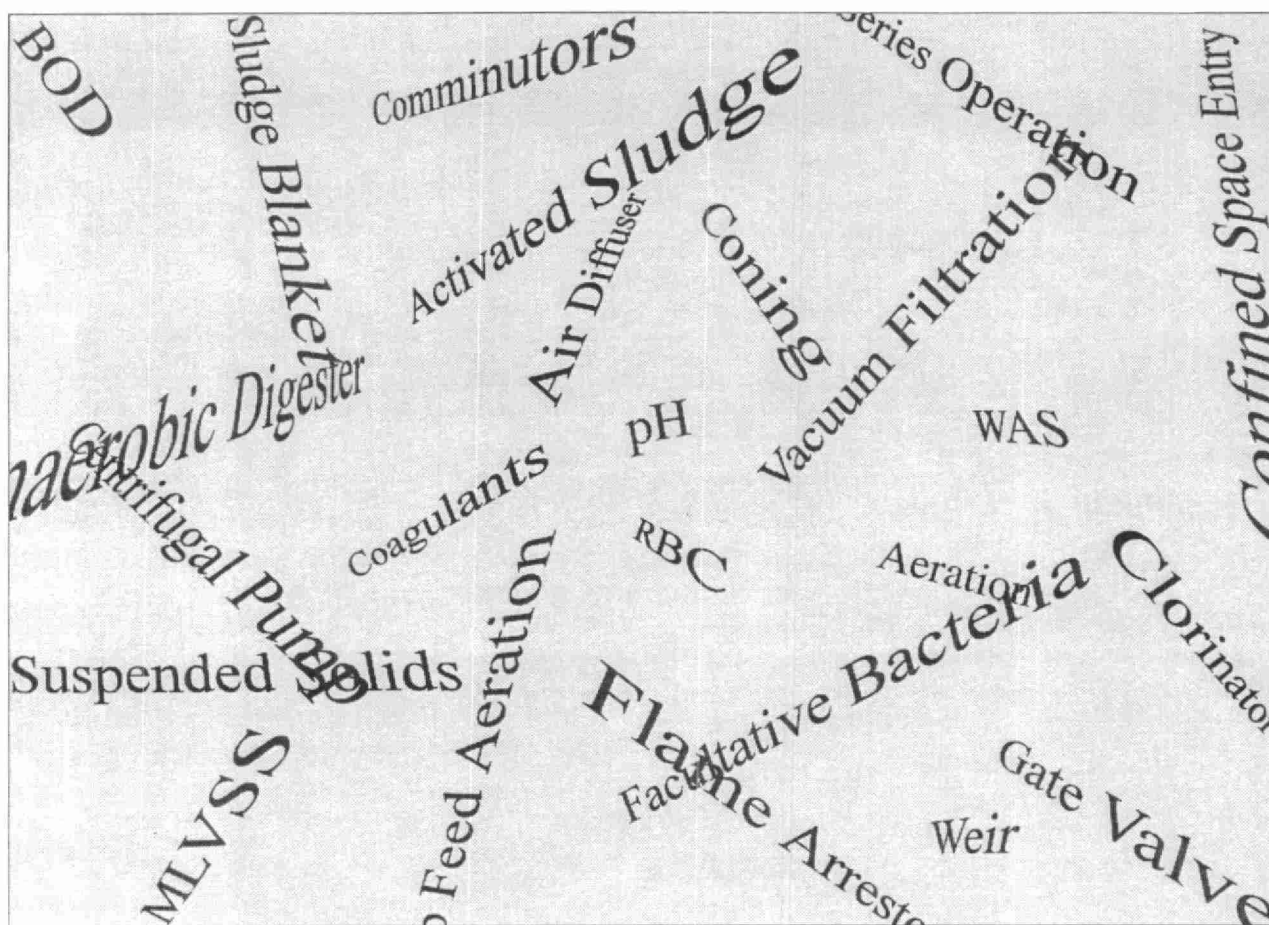


Wastewater Treatment Operator Need-To-Know

April 1996



ABC



Ontario

Ministry of Environment
and Energy

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FORWARD

This guide was created to help trainers, supervisors and operators determine what topics to review while studying for operator certification exams. The guide breaks each exam into numerous topics and indicates the level of knowledge required for each exam.

In 1995-96 a committee of experienced operators and supervisors reviewed the Association of Boards of Certification standard North American "Need-To-Know". From this review several revisions were made to reflect Ontario's operational needs. From the new, revised "Need-To-Know" the committee developed new certification exams.

The following individuals were members of the Wastewater Treatment Exam Review Committee:

Paul Cairns - Ontario Clean Water Agency
Bob Crane - Regional Municipality of Hamilton-Wentworth
Richard Connel - Ontario Clean Water Agency
Brian Gildner - Ministry of Environment and Energy
Philip King - Metro Toronto
Joe Lewis - Ontario Clean Water Agency
Ed Nevela - Dennis Consultants
Bram Rouw - Town of Hanover
Doug Supplesa - Region of Durham
Jim Williams - Ministry of Environment and Energy

ABOUT THE ASSOCIATION OF BOARDS OF CERTIFICATION

The Association of Boards of Certification (ABC) has been involved in developing water and wastewater operator certification programs, exams and support materials since 1966. ABC is a North American organization with members in 48 states and 9 provinces. Ontario became a full member of ABC in 1986 to support the introduction of the province's voluntary certification program. ABC provides the province with testing services, support materials and expertise from across North America.

Ontario exams are developed with assistance from the ABC and are fully recognized by the ABC. For details on reciprocity of Ontario exams outside of the province, contact the authority responsible for certification in the province/state which you are interested. Be sure to forward a copy of this "Need-To-Know".

INTRODUCTION

Before writing an exam, operators should be aware how each exam is developed. By understanding how the exams are made, it will be easier to study for the exam.

It is important to know that the exams are cumulative. This means that the knowledge required at a lower class is also required at higher classes. For example, a Class IV operator must know all Class IV topics as well as the Class I, II, and III topics. Generally, questions on a Class IV exam will be more difficult than questions on the same topic on lower class exams. In some cases technologies which are only used in Class I facilities will not be addressed at higher classes (i.e. wastewater stabilization ponds).

Although the exams are cumulative, each exam will emphasize different topics. For example in the "Processes Module" of Wastewater Treatment exams, Class I will emphasize lagoon systems; Class II will focus on primary treatment facilities; Class III secondary treatment; and Class IV full process/advanced treatment. Some questions dealing with processes normally found in higher Class facilities will be included in lower Class exams. These questions will be asked at a very basic knowledge level. At the top level, a Class IV operator is expected to master all topics. Since each exam emphasizes different topics an operator is not allowed to 'skip' exam levels (i.e. go from a Class I to a Class IV without first going through Class II and III).

Developing fair exams for wastewater operators is a challenge in a province containing relatively simple, small facilities along side large complex ones. Technologies which may be common in one size of facility may be absent in another. However, an operator who holds any Class of wastewater treatment licence may operate in any wastewater treatment system in the province. For this reason even at a Class I level operators will be expected to have a basic level of understanding or awareness in some of the common advanced processes or technologies (i.e. activated sludge). For this reason some of the questions on the exam may cover processes or technologies not used in the operator's facility. Although the question may not apply to your facility, it will be relevant for many other operators in the province.

The exams which are written in Ontario are similar to those in other provinces and states. Ontario uses the same format (multiple choice), same length (100 questions) and the same source of questions (the ABC question bank). By keeping the exams similar to the industry standard, the marks obtained by Ontario operators will be more readily accepted in other provinces and states.

HOW TO USE THE "NEED-TO- KNOW"

The "Need-to-Know" is designed as an aid for operators and supervisors. It contains three sections to help users determine the topics and level of training required to meet the requirements of certification examinations. The three sections are:

"General Exam Modules", provides a broad overview of the exams (*page 3*).

"Detailed Topic Breakdown", provides a detailed breakdown of the topics covered on each exam. It also provides an indication of the level of knowledge required for each topic (*pages 6-9*).

"Task Analysis", provides a further definition of the tasks and knowledge required for each topic at each Class (*pages 14-22*).

Together these three sections will help guide the operator while studying. For more information on study materials and course offerings refer to the booklet entitled **"Education & Certification Resource Guide for Water & Wastewater Utility Operators"**, available free from the Ministry of Environment and Energy's Certification Office.

GENERAL EXAM MODULES

Every exam is divided into 4 different modules. Each module is further divided into topics. Every question on the exam will fit into one of the topics. The 4 different modules are:

General Module: This module includes basic background knowledge and skills which are required by an operator to perform his/her duties. Some of the skills and knowledge may be obtained prior to becoming an operator, in school or at other work experiences. Others will be specific to the water/wastewater industry. This knowledge is applied on a daily basis by the operator to complete his/her job (i.e. arithmetic calculation of chemical feed rates).

Support Systems Module: This module includes the equipment/materials necessary to perform water/wastewater processes. Pumps, compressors and engines are some of the equipment covered. The module also includes conveyance (piping, fittings, valves joints etc.) and measuring and control systems. Operators will be expected to be familiar with the operation and troubleshooting aspects of this equipment. Detailed maintenance of the equipment is not covered in the exam.

Processes Module: This module focuses on the processes involved in wastewater treatment. This module is the main focus for the exams, requiring the operator to demonstrate knowledge in the day to day operation of the processes at a facility. Included in this module are equipment specific to processes (i.e. comminutors, chlorinators, vacuum filters, RBCs, etc.). Operators will be expected to know how to operate this equipment, its relationship to the overall treatment process and basic troubleshooting. Detailed maintenance of this equipment is beyond the scope of the exams.

Administration Module: This module covers administrative functions which support the on-going operation of a facility. Depending on the class of exam, operators will be expected to demonstrate basic knowledge and understanding of supervision, finance, communication, site security, information systems and emergency response procedures.

Below is a table indicating the percentage of questions in each of the modules.

PERCENTAGE BREAKDOWN FOR EACH EXAM MODULE					
		CLASS I EXAM	CLASS II EXAM	CLASS III EXAM	CLASS IV EXAM
GENERAL MODULE					
	GENERAL MATH	10%	5%	0%	0%
	SAFETY	10%	5%	5%	5%
	APPLIED SCIENCE	10%	10%	5%	5%
SUPPORT SYSTEMS MODULE		15%	10%	10%	10%
PROCESS MODULE		47%	62%	65%	65%
ADMINISTRATION MODULE					
	MANAGEMENT	3%	3%	8%	8%
	ADMINISTRATION	5%	5%	7%	7%
TOTAL:		100%	100%	100%	100%
PERCENT QUESTIONS REQUIRING ARITHMETIC CALCULATIONS					
CALCULATING		10%	12%	15%	15%
NON-CALCULATING		90%	88%	85%	85%

DETAILED TOPIC BREAKDOWN

The above table also indicates the number of questions which require arithmetic calculations. These questions will be scattered throughout the various modules. In Class I and II exams most of the questions will be in the General Module (General Math Section). In higher Classes the questions will be in the Support Systems Module (i.e. pump, chemical feeder questions), the Process Module (i.e. activated sludge, disinfection questions), or the Administration Module (i.e. finance questions). Generally the Class III and IV questions which require calculations are more difficult. These questions require problem solving abilities in addition to arithmetic skills.

The *Detailed Topic Breakdown* lists the skills, knowledge, equipment, processes, laboratory analysis, and administrative components of the operator's job. It is a table containing all of the examination topics. Each topic is also given a 'mastery rating'. This rating will give operators some indication of the level of difficulty for each topic. The mastery ratings are:

- Basic:** Operators must understand the importance of the topic; and how it relates to the overall operation of the system. Basic terminology and concepts are covered.
- Intermediate:** Operators must have working or functional knowledge/skill in the topic.
- Advanced:** Operators must be able to evaluate the topic and fully understand the interaction of the topic with the overall operation of the system.

Intermediate levels include all *basic* levels. *Advanced* levels include all *intermediate* and *basic* levels.

Most of the topics in the *Detailed Topic Breakdown* have footnotes. On pages 11-13 the footnotes provide a more detailed description of the topic. Further detail is provided in the *Task Analysis*.

TASK ANALYSIS

The *Task Analysis* listings, which follows the *Detailed Topic Breakdown*, lists the performance objectives for each topic. The performance objectives are broken down into Basic, Intermediate and Advanced levels. These are the same levels of mastery which are listed in the *Detailed Topic Breakdown*. The *Task Analysis* provides operators with greater detail on the learning objectives for each topic.

Using the *Detailed Topic Breakdown* and the *Task Analysis* listings:

The objectives listed in the *Task Analysis* are used in combination with the topics in the *Detailed Topic Breakdown*. These will help to define what an operator needs to know in each topic. The *Detailed Topic Breakdown* indicates the level of mastery of the exam topics. The *Task Analysis* state performance objectives for each topic by the difficulty level (Basic, Intermediate and Advanced).

To successfully complete an ABC examination, an operator must demonstrate knowledge of the *Task Analysis* performance objectives for each *Detailed Topic Breakdown* topic according to the rating assigned to the topic. Following is an example of how to use the *Detailed Topic Breakdown* and *Task Analysis*.

An operator would like to know what information is required to pass the topic called Hydraulic Concepts on a Class II exam.

1. First the operators should look in the *Detailed Topic Breakdown* (the table starting on page 6) for the topic entitled "Hydraulic Concepts".
2. For a Class II exam the rating assigned to Hydraulic Concepts is *Intermediate*.
3. The operator must know how to perform all *Intermediate* tasks for Hydraulic Concepts.
4. Next, the operator observes that a number ⁶ appears after the topic heading. This indicates that a more detailed description of the topic is given at the end of the *Detailed Topic Breakdown*. The operator turns to page 11 to read the description.
5. The operator now refers to the *Task Analysis* section.
6. In the left column of the General Module (page 14) it states that:
"A: The operator must complete the following performance objectives as indicated":
7. Under Hydraulic Concepts (page 15-16) the *Intermediate* objectives are:
 - 6.3 Calculate pumping head, pressure head, static head
 - 6.4 Using hydraulic concepts and terms explain how a pump functions
8. The operator must also meet all of the objectives stated under the *Basic* level:
 - 6.1 Define basic hydraulic concepts (head, pressure, rate of flow).
 - 6.2 Explain the movement and properties of liquid under pressure.
9. The operator must be able to meet all of the stated objectives for the topic.



ONTARIO WASTEWATER TREATMENT EXAM DETAILED TOPIC BREAKDOWN						
GENERAL MODULE			Class I	Class II	Class III	Class IV
100	General Math Section					
101		Basic & Applied Math ¹	Intermediate	Advanced	Advanced	Advanced
102		Units of Expression ²	Advanced	Advanced	Advanced	Advanced
110	Applied Science Section					
111		Basic & Applied Science ³	Basic	Intermediate	Advanced	Advanced
112		Public Health Principles ⁴	Intermediate	Advanced	Advanced	Advanced
113		Electrical Concepts ⁵	Basic	Intermediate	Intermediate	Intermediate
114		Hydraulic Concepts ⁶	Basic	Intermediate	Intermediate	Intermediate
115		Maps & Plans ⁷	Basic	Intermediate	Intermediate	Intermediate
120	Safety Section					
121		Safety Procedures ⁸	Advanced	Advanced	Advanced	Advanced
122		Safety Equipment ⁹	Advanced	Advanced	Advanced	Advanced
SUPPORT SYSTEMS MODULE			Class I	Class II	Class III	Class IV
201	Electrical Controls ¹⁰ / Transformers		Basic	Intermediate	Advanced	Advanced
202	Battery Banks		Basic	Intermediate	Advanced	Advanced
203	Motors ¹¹ / Drives ¹²		Intermediate	Advanced	Advanced	Advanced
204	Pumps					
		Air Lift	Advanced	Advanced	Advanced	Advanced
		Centrifugal	Intermediate	Advanced	Advanced	Advanced
		Positive Displacement ¹³	Intermediate	Advanced	Advanced	Advanced
		Screw	Advanced	Advanced	Advanced	Advanced
		Turbine	Intermediate	Advanced	Advanced	Advanced
205	Blowers & Compressors ¹⁴		Intermediate	Advanced	Advanced	Advanced
206	Generators ¹⁵		Intermediate	Advanced	Advanced	Advanced
207	Engines ¹⁶		Intermediate	Advanced	Advanced	Advanced
208	Pipes		Intermediate	Advanced	Advanced	Advanced
209	Joints ¹⁷		Intermediate	Advanced	Advanced	Advanced
210	Valves ¹⁸		Intermediate	Advanced	Advanced	Advanced
211	Fittings ¹⁹		Intermediate	Advanced	Advanced	Advanced

SUPPORT SYSTEMS MODULE		Class I	Class II	Class III	Class IV
212	Cathodic Protection Devices ²⁰ / Corrosion Control	Basic	Intermediate	Advanced	Advanced
213	Hydrants	Basic	Basic	Basic	Basic
214	Measuring & Control Systems ²¹	Basic	Intermediate	Advanced	Advanced
215	Chemical Feeders ²²	Intermediate	Advanced	Advanced	Advanced
216	Rolling Stock ²³	Intermediate	Advanced	Advanced	Advanced
217	HVAC ²⁴	Basic	Intermediate	Advanced	Advanced
218	Cross-Connection & Backflow	Intermediate	Advanced	Advanced	Advanced
PROCESSES MODULE		Class I	Class II	Class III	Class IV
301	Sources & Characteristics ²⁵	Intermediate	Intermediate	Advanced	Advanced
302	Quality Control & Assurance ²⁶	Advanced	Advanced	Advanced	Advanced
303	Compliance ²⁷	Advanced	Advanced	Advanced	Advanced
304	Flow Equalization	Intermediate	Advanced	Advanced	Advanced
305	Screening ²⁸	Advanced	Advanced	Advanced	Advanced
306	Grinding ²⁹	Advanced	Advanced	Advanced	Advanced
307	Grit Removal ³⁰	Advanced	Advanced	Advanced	Advanced
308	Aeration	Advanced	Advanced	Advanced	Advanced
309	Chemical Pretreatment	Basic	Intermediate	Advanced	Advanced
310	Clarification ³¹	Advanced	Advanced	Advanced	Advanced
311	Trickling Filters ³²	Basic	Intermediate	Advanced	Advanced
312	Activated Sludge				
	Conventional	Basic	Intermediate	Advanced	Advanced
	Step Feed	Basic	Intermediate	Advanced	Advanced
	Sequential Batch Reactor (SBR)		Basic	Intermediate	Advanced
	High Rate	Basic	Basic	Basic	Basic
	Contact Stabilization	Basic	Intermediate	Advanced	Advanced
	Extended Aeration	Basic	Intermediate	Advanced	Advanced
	Tapered Aeration	Basic	Intermediate	Advanced	Advanced
	Complete Mix	Basic	Intermediate	Advanced	Advanced
	Pure Oxygen		Basic	Basic	Basic
313	Waste Stabilization Ponds ³³	Advanced	Advanced	Advanced	Advanced
314	Rotating Biological Contactors	Intermediate	Intermediate	Advanced	Advanced

PROCESSES MODULE		Class I	Class II	Class III	Class IV
315	ABF Systems (Activated Biofilter)		Basic	Intermediate	Advanced
316	Disinfection	Advanced	Advanced	Advanced	Advanced
317	Filtration ³⁴	Basic	Intermediate	Advanced	Advanced
318	Microscreen		Basic	Intermediate	Advanced
319	Coagulation & Flocculation	Basic	Intermediate	Advanced	Advanced
320	Adsorption	Basic	Intermediate	Advanced	Advanced
321	Nitrogen Removal	Intermediate	Advanced	Advanced	Advanced
322	Phosphorus Removal	Intermediate	Advanced	Advanced	Advanced
323	Effluent Disposal				
	Discharge	Advanced	Advanced	Advanced	Advanced
	Direct Reuse		Basic	Basic	Basic
324	Sludge Conditioning	Intermediate	Advanced	Advanced	Advanced
325	Sludge Thickening	Intermediate	Advanced	Advanced	Advanced
326	Sludge Aerobic Digestion	Intermediate	Advanced	Advanced	Advanced
327	Sludge Anaerobic Digestion	Intermediate	Advanced	Advanced	Advanced
328	Sludge Drying Beds	Basic	Basic	Basic	Basic
329	Sludge Vacuum Filters	Basic	Basic	Basic	Basic
330	Sludge Filter Press	Basic	Intermediate	Advanced	Advanced
331	Sludge Belt Press	Basic	Intermediate	Advanced	Advanced
332	Sludge Centrifuges	Basic	Intermediate	Advanced	Advanced
333	Solids Disposal				
	Solids Incineration ³⁵		Basic	Intermediate	Intermediate
	Landfill Solids	Intermediate	Advanced	Advanced	Advanced
	Land Application of Solids	Intermediate	Advanced	Advanced	Advanced
	Composting Solids	Basic	Basic	Basic	Basic

PROCESSES MODULE		Class I	Class II	Class III	Class IV
334	Laboratory - Plant Process Tests ³⁶				
	BOD	Advanced	Advanced	Advanced	Advanced
	Chlorine Residual	Advanced	Advanced	Advanced	Advanced
	COD	Basic	Intermediate	Advanced	Advanced
	Dissolved Oxygen	Advanced	Advanced	Advanced	Advanced
	Microexam	Intermediate	Advanced	Advanced	Advanced
	pH	Advanced	Advanced	Advanced	Advanced
	Phosphorus	Basic	Intermediate	Advanced	Advanced
	Solids				
	30 Minute Settleable	Advanced	Advanced	Advanced	Advanced
	SS	Advanced	Advanced	Advanced	Advanced
	TDS	Advanced	Advanced	Advanced	Advanced
	Total	Advanced	Advanced	Advanced	Advanced
	VSS	Advanced	Advanced	Advanced	Advanced
	Settleability (SVI)	Advanced	Advanced	Advanced	Advanced
	Temperature	Advanced	Advanced	Advanced	Advanced
	Turbidity	Basic	Basic	Intermediate	Advanced
	Volatile Acids	Intermediate	Advanced	Advanced	Advanced
335	General Lab Tests ³⁷	Basic	Basic	Intermediate	Advanced
ADMINISTRATION MODULE		Class I	Class II	Class III	Class IV
410	Management				
411	Planning ³⁸	Basic	Intermediate	Advanced	Advanced
412	Personnel ³⁹	Basic	Intermediate	Advanced	Advanced
413	Finances ⁴⁰	Basic	Intermediate	Advanced	Advanced
420	Administration				
421	Maintenance Management ⁴¹	Basic	Intermediate	Advanced	Advanced
422	Information ⁴²	Basic	Intermediate	Advanced	Advanced
423	Emergency Response ⁴³	Advanced	Advanced	Advanced	Advanced
424	Public Relations ⁴⁴	Advanced	Advanced	Advanced	Advanced
425	Security ⁴⁵	Basic	Intermediate	Advanced	Advanced

In each exam, certain topics in the Processes Module are emphasized. In the table below the main topics for each class of exam are given. Only topics with at least 2 questions are included. The topics are listed in order of importance. For example on a Class 1 exam there are more questions on waste stabilization ponds than questions dealing with laboratory knowledge. Likewise there are more questions on disinfection than there are on compliance.

PROCESSES MODULE - PRIORITY TOPICS				
	CLASS I	CLASS II	CLASS III	CLASS IV
High  Number of Questions  Low	<ul style="list-style-type: none"> ★ Waste stabilization ponds (lagoons) ★ Laboratory ★ Disinfection ★ Compliance ★ Grit removal ★ Activated sludge ★ Sources & characteristics 	<ul style="list-style-type: none"> ★ Activated sludge ★ Aeration ★ Laboratory ★ Sludge digestion (Aerobic) ★ Disinfection ★ Solids disposal ★ Compliance ★ Sludge dewatering ★ Grit removal ★ Sludge digestion (Anaerobic) ★ Clarification ★ Sources & characteristics 	<ul style="list-style-type: none"> ★ Activated sludge ★ Sludge digestion (Aerobic) ★ Solids disposal ★ Aeration ★ Laboratory ★ Advanced treatment ★ Sludge dewatering ★ Disinfection ★ Filtration ★ Sludge digestion (Anaerobic) ★ Clarification 	<ul style="list-style-type: none"> ★ Activated sludge ★ Advanced treatment ★ Solids disposal ★ Sludge digestion (Aerobic) ★ Laboratory ★ Sludge conditioning/thickening ★ Aeration ★ Sludge dewatering ★ Disinfection ★ Filtration ★ Nitrogen removal ★ Phosphorus removal

ENDNOTES: TOPIC DESCRIPTIONS

General Module

The numbers below refer to the topics listed in the above table entitled "Ontario Wastewater Treatment Exam Detailed Topic Breakdown" (pages 6-9). The below endnotes provide a greater description of the topic, by providing an indication of the equipment and processes involved.

- 1 **Basic and Applied Math** - Calculating volume, area, flow rates, feed rates, percentages, ratios, squares, cubes, roots, ability to calculate water/wastewater formulas.
- 2 **Units of Expression** - Imperial, metric, conversion between imperial and metric, common metric prefixes.
- 3 **Basic & Applied Science** - Chemistry (common water/wastewater chemicals, chemical reactions, basic chemistry terms: [pH and related concepts, oxidation/reduction, ionization etc], mixtures and solutions) physical properties of liquids, solids and gases, BOD, COD.
- 4 **Public Health Principles** - Microbiology (pathogens, wastewater organisms), microbiological testing (coliform testing), effects of effluent on public and environmental health.
- 5 **Electrical Concepts** - Electrical units (volt, amperes, ohms, watts), electrical circuits, electrical terminology.
- 6 **Hydraulic Concepts** - Rate of flow, pressure, head (static, friction, pressure), pump hydraulics (work, power, horsepower, efficiency).
- 7 **Maps and Plans** - Maps, blue prints, site diagrams, equipment specifications.
- 8 **Safety Procedures** - Occupational Health and Safety Act, WHMIS, owner/operator responsibilities, construction safety, plant safety, electrical safety, infections and infectious diseases, hazardous gases, chemical handling, chemical labels, confined space entry.
- 9 **Safety Equipment** - Personal protection gear, traffic control/public safety (warning devices, barricades), hazard detection, first aid/hygiene, gas detection equipment
- 10 **Electrical Controls** - Electrical circuits, circuit testing, fuses, protective devices, circuit breakers, overload relays, motor starters.
- 11 **Motors** - Single Phase, Poly Phase, Variable Speed
- 12 **Drives** - Coupled, Direct (Shaft, Gear), Speed Reducer (Fixed, Variable), Right Angle
- 13 **Positive Displacement Pumps** - Piston Plunger, Progressive Cavity, Diaphragm
- 14 **Blowers & Compressors** - Centrifugal, Positive Displacement (Rotary, Piston)
- 15 **Generators** - AC, DC

Support Systems Module

Processes Module

- 16 **Engines** - Gasoline, Diesel, Gas
- 17 **Joints** - Flanged, Compression, Dresser, Victaulic, Fused, Threaded
- 18 **Valves** - Ball, Check, Globe, Gate, Plug Petcock, Pressure Control, Vacuum Relief, Aud, Butterfly, Multiport, Telescoping Sluice Gate, Air Release , Foot, Altitude
- 19 **Fittings** - Coupling Union, Plug/Caps, Special
- 20 **Cathodic Protection Devices** - Anode Rod/Bags, Cathode Rod/Bags, Rectifiers, Potentiometers
- 21 **Measuring and Control** - Signal Generators (Kennison Nozzle, Magnetic Flowmeter, Parshall Flume, Proportional Weir, Rectangular Weir, Venturi, Propeller Meter, Ultrasonic, Pitot Tube), Signal Transmitters (Electric, Pneumatic, Hydraulic, Mechanical, Telemetry), Signal Receivers (Counters, Indicators, Log Scale Indicators, Totalizers, Recorders, Combination Recorders), Meters (Hydraulic-Rotameter, Electrical-Amp, Electrical-Watt [Watt Hour Meter], Electrical-Multitester VOM], Electrical-Megger, Mechanical-RPM), Alarms, Controls (Pneumatic, Float, Hydraulic, Electrical, Telemetry, Timers)
- 22 **Chemical Feeders** - Solids, Liquids, Evaporators, Gas, Slurry
- 23 **Rolling Stock** - Service Vehicles, Fork Lifts, Trucks, Tractors, Trailers, Lawn Mowers, Loaders, Portable Pumps, Generators
- 24 **HVAC** - Heat Exchangers, Dehumidifiers, Fans, Compressors, Condensers, Boilers
- 25 **Sources & Characteristics** - Typical types of waste effluent from various industries, chemical, biological and physical characteristics of industrial, commercial and domestic effluent, municipal flow patterns (infiltration, storm and daily flows).
- 26 **Quality Control & Assurance (QA/QC)** - Indicators of process/effluent quality, quality control procedures.
- 27 **Compliance** - Ontario environmental legislation affecting wastewater treatment plants, scope and authority of certificates of approval, owner/operator responsibilities.
- 28 **Screening** - Hand Cleaned Bar Screens, Mechanically Cleaned Bar Screens, Static Screens
- 29 **Grinding** - Grinders, Communiters, Barminuters
- 30 **Grit Removal** - Hand cleaned, mechanically cleaned, aerated.
- 31 **Clarification** -- Primary Clarifiers (Rectangular, Circular), Imhoff Tank
- 32 **Trickling Filters** - Standard Rate, High Rate, Roughing
- 33 **Waste Stabilization Ponds** -- Aerobic, Facultative, Anaerobic, Aerated, Discharging, Total Containment
- 34 **Filtration** -- Rapid Sand Filters, Mixed or Multi-Media Filters, Pressure Filters, Intermittent Filters

Administration Module

- 35 ***Solids Incineration*** - Fluidized bed, multiple hearth, wet oxidation
- 36 ***Laboratory - Plant Process Tests*** - Tests routinely conducted on site by operators, often using portable equipment. Includes BOD, residual chlorine, dissolved oxygen, pH, solids, phosphorus, temperature, turbidity and volatile acids.
- 37 ***General Lab Tests*** - Lab tests conducted by laboratory technicians (Alkalinity, ammonia, arsenic, cadmium, calcium, centrifuge test, chloride, chlorinated organics, chromium, COD, coliforms, colour, conductance, copper, cyanide, iron, Kjeldahl nitrogen, manganese, mercury, nickel, nitrate, nitrite, oil and grease, pesticides, phenol, potassium, selenium, silver, sodium, sulphate, sulphide, sulphite, surfactants, total organic carbon, zinc), basic understanding of test purpose, acceptable ranges, meaning of lab results.
- 38 ***Planning*** - Facility planning, decision making.
- 39 ***Personnel*** - Supervision/management, hiring, disciplining, interviews, communication,
- 40 ***Finances*** - Budgets, procurement, purchasing, inventory control/management.
- 41 ***Maintenance Management*** - Maintenance procedures (general),
- 42 ***Information*** - Record keeping, computer systems, reports.
- 43 ***Emergency Response*** - Spill response, fire, explosion, bomb threat, natural emergencies, hydraulic overload, slug loads, process failure.
- 44 ***Public Relations*** - Communication with public, complaint investigation, disclosure of information.
- 45 ***Security*** - Security of facility and property, prevention of vandalism, theft, security of staff, security of product.

TASK ANALYSIS

General Module

A. Operator must complete the following performance objectives as indicated:

The listing below provides more detail on the types and level of knowledge required for each of the topics for each Class of exam.

Basic and Applied Math (Topic 101)

Basic & Intermediate Tasks

- 1.1 Perform addition, subtraction, multiplication and division of whole numbers and decimals
- 1.2 Square and cube whole numbers, proper fractions, improper fractions, mixed numbers and decimals
- 1.3 Using conventional formulas, calculate area of rectangles, triangles, and circles; surface area and volume of cylinders, cones, and spheres

Advanced Tasks - Basic tasks plus:

- 1.4 Convert fractions to percentage and vice-versa
- 1.5 Plot and interpret graphs, including line, bar, percentage, and broken line
- 1.6 Develop and read tables
- 1.7 Using conventional formulas, solve for direct and inverse proportions
- 1.8 Using conversion reference, convert from English to metric and vice-versa
- 1.9 Calculate percent removal
- 1.10 Interpret word problems, obtaining the required values and formulas
- 1.11 Use standard water/wastewater formulas

Units of Expression (Topic 102)

Basic, Intermediate & Advanced Tasks:

- 2.1 Define terms of expression, such as ppm, mg/L, MG/d
- 2.2 Convert from one unit to another using appropriate references or formulas; convert from imperial to metric units

Basic and Applied Science (Topic 111)

Basic Tasks:

- 3.1 Define concepts in basic chemistry
- 3.2 Identify and describe chemicals used in wastewater treatment
- 3.3 Define and describe the significance of basic concepts in wastewater chemistry
- 3.4 Define and describe the significance of basic concepts in microbiology, including viruses, bacteria, and protozoa

Intermediate Tasks - Basic tasks plus:

- 3.5 Read common wastewater chemical formulas and equations
- 3.6 Explain and describe the significance of microbiological organisms in biological treatment

Advanced Tasks - Basic and Intermediate tasks plus:

- 3.7 Describe and explain the significance of common chemical reactions in wastewater treatment
- 3.8 Describe the properties and movement of gas under pressure.

Public Health Principles (Topic 112)**Basic & Intermediate Tasks:**

- 4.1 Describe public health principles, laws, and regulations

Advanced Tasks - Intermediate tasks plus:

- 4.2 Identify chemicals contained in wastewater or effluent which are hazardous to human health
- 4.3 Explain how wastewater or wastewater effluent can effect stream/lake environmental health

Electrical Concepts (Topic 113)**Basic Tasks:**

- 5.1 Identify the basic electrical units and explain their meaning
- 5.2 Identify the safety requirements when working on electrical equipment
- 5.3 Using basic electrical concepts explain the safety hazards associated with electricity

Intermediate Tasks - Basic tasks plus:

- 5.4 Identify the types of electrical circuits found in wastewater facilities.

Advanced Tasks - Basic and Intermediate tasks plus:

- 5.5 Explain the basic principles of common electrical circuits
- 5.6 Identify the electrical requirements of different types of equipment

Hydraulic Concepts (Topic 114)**Basic Tasks:**

- 6.1 Define basic hydraulic concepts (head, pressure, rate of flow).
- 6.2 Explain the movement and properties of liquid under pressure.

Intermediate Tasks - Basic tasks plus:

- 6.3 Calculate pumping head, pressure head, static head
- 6.4 Using hydraulic concepts and terms explain how a pump functions

Advanced Tasks - Basic and Intermediate tasks plus:

- 6.5 Describe the relationship between pumping head, horsepower and pump efficiency
- 6.6 Calculate horsepower and pumping efficiencies
- 6.7 Understand the basic hydraulic principles behind common flow measurement devices

Maps and Plans (Topic 115)**Basic Tasks:**

- 7.1 Interpret and use maps and plans

Intermediate and Advanced Tasks - Basic tasks plus:

- 7.2 Calculate grades and changes in elevation

Safety Procedures and Equipment (Topic 121/122)**Basic, Intermediate & Advanced Tasks:**

- 8.1 Identify basic categories of safety hazards
- 8.2 Identify basic safety procedures
- 8.3 Identify violations of personal hygiene
- 8.4 Describe personal safety procedures
- 8.5 Describe fire safety procedures
- 8.6 Describe chemical safety procedures
- 8.7 Describe confined space safety procedures

Support Systems Module

A: Perform operating procedures associated with the normal and abnormal conditions for support systems/equipment

Support Systems Modules (Topics 201-220)**Basic Tasks**

- 9.1 Identify safety hazards
- 9.2 Identify correct safety procedures
- 9.3 Perform necessary calculations
- 9.4 Record necessary information
- 9.5 Describe purpose of system/equipment/components
- 9.6 Relate necessary information to others

Intermediate Tasks - Basic tasks plus

- 9.7 Recognize indicators of normal and abnormal conditions
- 9.8 Perform actions at appropriate time, location and frequency
- 9.9 Use necessary tools/test equipment/reference manuals

	<p>Advanced Tasks - Intermediate tasks plus</p> <p>9.10 Identify causes of abnormal conditions using proper troubleshooting techniques</p> <p>9.11 Explain reasons for taking these actions, including consequences of not taking action</p> <p>9.12 Explain interaction with other support systems/equipment and the total treatment process</p> <p>9.13 Identify the applicable standards imposed by process parameters, laws, and regulators</p>
<p>B. Perform start-up/shut-down procedures on support systems/equipment</p>	<p>Basic Tasks</p> <p>10.1 Identify safety hazards</p> <p>10.2 Identify correct safety procedures</p> <p>10.3 Perform necessary calculations</p> <p>10.4 Record necessary information</p> <p>10.5 Relate necessary information to others</p> <p>Intermediate Tasks - Basic tasks plus</p> <p>10.6 Identify conditions requiring start-up/shut-down of the support system/equipment</p> <p>10.7 Perform necessary actions at appropriate the, location and frequency</p> <p>10.8 Use necessary tools/test equipment/reference manuals</p> <p>Advanced Tasks - Intermediate tasks plus</p> <p>10.9 Explain reasons for taking these actions including consequences of not taking action</p> <p>10.10 Explain interaction with other support systems/equipment and the total treatment process</p> <p>10.11 Identify the applicable standards imposed by process parameters, laws, and regulations</p>
<p>Processes Module</p> <p>A. Operator must complete the following performance objectives as indicated:</p>	<p><u>Sources and Characteristics (Topic 301)</u></p> <p>Basic & Intermediate Tasks</p> <p>11.1 Identify sources</p> <p>11.2 Describe source quality and quantity</p> <p>Advanced Tasks - Intermediate tasks plus:</p> <p>11.3 Identify physical, chemical, and biological characteristics</p> <p>11.4 Identify physical, chemical and biological characteristics</p>

Quality Control and Assurance (Topic 302)

Basic, Intermediate & Advanced Tasks:

- 12.1 Perform quality control and assurance procedures

Compliance (Topic 303)

Basic, Intermediate & Advanced Tasks:

- 13.1 List the relevant regulations, acts and other legal documents
13.2 Perform all tasks in compliance with legislation and Certificates of Approval

B. Perform operating procedures associated with normal and abnormal conditions for processes/units

Unit Processes (Topics 304 - 333)

Basic Tasks

- 14.1 Identify safety hazards
14.2 Identify correct safety procedures
14.3 Perform necessary calculations
14.4 Record necessary information
14.5 Sketch and describe each element
14.6 Describe purpose of the process/units/components
14.7 Relate necessary information to others

Intermediate Tasks - Basic tasks plus

- 14.8 Recognize indicators of normal and abnormal conditions
14.9 Perform necessary actions at appropriate the location and frequency
14.10 Use necessary tools / test equipment/reference manuals

Advanced Tasks - Intermediate tasks plus

- 14.11 Identify causes of abnormal conditions using proper trouble shooting techniques
14.12 Explain reasons for taking these actions, including consequences of not taking action
14.13 Explain interaction with other processes/units and the total treatment process
14.14 Identify the applicable standards imposed by process parameters, legislation and Certificate of Approval

C. Perform start-up/shut-down procedures on processes/units

Basic Tasks

- 15.1 Identify safety hazards/safety procedures
15.2 Perform necessary calculations
15.3 Record necessary information
15.4 Relate necessary information to others

	<p>Intermediate Tasks - Basic tasks plus</p> <ul style="list-style-type: none"> 15.5 Identify conditions requiring start-up/shut-down of the process/unit 15.6 Perform necessary actions at the appropriate location and frequency 15.7 Use necessary tools/ test equipment/reference manuals <p>Advanced Tasks - Intermediate tasks plus</p> <ul style="list-style-type: none"> 15.8 Explain reasons for taking these actions, including consequences of not taking action 15.9 Explain interaction with other processes/units and the total treatment process 15.10 Identify applicable standards imposed by process parameters, legislation and Certificate of Approval
<p>D. Perform construction and installation procedures for processes/units</p>	<p>Basic Tasks</p> <ul style="list-style-type: none"> 16.1 Identify safety hazards 16.2 Identify correct safety procedures 16.3 Perform necessary calculations 16.4 Record necessary information <p>Intermediate Tasks - Basic tasks plus</p> <ul style="list-style-type: none"> 16.5 Perform actions at appropriate time, location and frequency 16.6 Use necessary tools/test equipment/reference manuals <p>Advanced Tasks - Intermediate tasks plus</p> <ul style="list-style-type: none"> 16.7 Interpret plans specifications, and other references 16.8 Explain reasons for taking these actions including consequences of not taking action 16.9 Explain interaction with other processes/unit and the total treatment process 16.10 Identify applicable standards imposed by process parameters, legislation and Certificate of Approval 16.11 Perform inspection procedures
<p>E. Operator must complete the following performance objectives as indicated:</p>	<p><u>Laboratory - Plant Process Tests (Topic 333)</u></p> <p>Basic Tasks:</p> <ul style="list-style-type: none"> 17.1 Interpret chemical labels and standard shipping label of chemicals 17.2 Label containers 17.3 Describe proper use and care of laboratory/sampling/testing equipment 17.4 Take samples using proper procedures

- 17.5 Transport samples using proper procedures
- 17.6 Store samples using proper procedures
- 17.7 Identify safety hazards
- 17.8 Identify correct safety procedures
- 17.9 Perform necessary calculations
- 17.10 Record necessary information on all required logs/reports
- 17.11 Relate necessary information to others

Intermediate Tasks - Basic tasks plus:

- 17.12 Prepare sample containers using proper procedures
- 17.13 Specify time and frequency for taking samples
- 17.14 Select sample location using proper procedures
- 17.15 Analyse sample using proper procedures
- 17.16 Interpret test results
- 17.17 Use lab/sampling/testing equipment and related manuals
- 17.18 Describe purpose of test/procedure

Advanced Tasks - Basic and Intermediate tasks plus:

- 17.19 Prepare or obtain reagents using proper procedures
- 17.20 Make appropriate decision(s) concerning results which indicate abnormal conditions
- 17.21 Explain reasons for using proper procedures and the consequences of not using these procedures
- 17.22 Identify applicable standards imposed by process parameters, legislation and Certificate of Approval

General Lab Tests (Topic 335)

Basic Tasks:

- 18.1 Label containers
- 18.2 Take samples using proper procedures
- 18.3 Transport samples using proper procedures
- 18.4 Store samples using proper procedures
- 18.5 Identify safety hazards
- 18.6 Identify correct safety procedures
- 18.7 Perform necessary calculations
- 18.8 Record necessary information on all required logs/reports
- 18.9 Relate necessary information to others

Intermediate Tasks - Basic tasks plus:

- 18.10 Prepare sample containers using proper procedures
- 18.11 Specify time and frequency for taking samples
- 18.12 Select sample location using proper procedures
- 18.13 Interpret test results
- 18.14 Describe purpose of test/procedure

Administration Module

- A. Develop master plan to include objectives (short and long term, review, update), strategies, financial support and presentation to key personnel; prepare management practices to implement the master plans objectives and strategies; implement the management practices to accomplish master plan objectives to organize, coordinate, and direct and control; and evaluate the effectiveness of the master plan and management practices

Advanced Tasks - Basic and Intermediate tasks plus:

- 18.15 Make appropriate decision(s) concerning results which indicate abnormal conditions
- 18.16 Identify applicable standards imposed by process parameters, legislation and Certificate of Approval

Management (Topics 411-413)

Basic Tasks

- 19.1 Perform necessary financial calculations (basic budget, accounts payable, calculation of unit costs)
- 19.2 Describe the importance of documenting meetings, management decisions, dealings with staff
- 19.3 Describe the purpose of good management practices
- 19.4 Describe the elements of an effective office communication strategy
- 19.5 Define and use basic financial/purchasing terms and concepts
- 19.6 Define and differentiate basic management/supervisory terms and concepts
- 19.7 Describe the components of a short/long term plan

Intermediate Tasks - Basic tasks plus

- 19.8 Recognize indicators of good management practices
- 19.9 Relate management systems to others within the plant
- 19.10 Evaluate the effectiveness of master plans for meeting facility objectives
- 19.11 Describe good task coordination and delegation techniques/methods

Advanced Tasks - Intermediate tasks plus

- 19.12 Differentiate between appropriate and inappropriate actions with subordinates and the consequences of each
- 19.13 Explain the interaction of different management practices
- 19.14 Set facility objectives based upon facility performance and resources
- 19.15 Set goals, overall objectives and identify methods to obtain the goals/objectives

Administration (Topics 421-425)

Basic Tasks

- 20.1 Take appropriate actions to maintain facility security
- 20.2 Record necessary information
- 20.3 Use necessary reference materials

- 20.4 Communicate effectively with the public
- 20.5 Describe the appropriate actions which should be completed during various types of emergency situations
- 20.6 Explain the purpose for maintaining logs and records
- 20.7 Explain the purpose of an effective maintenance management system
- 20.8 Describe routine maintenance procedures for common facility processes

Intermediate Tasks - Basic tasks plus

- 20.9 Develop an effective public relations policy
- 20.10 Develop an effective maintenance management program
- 20.11 Perform necessary actions (reporting, maintenance management, planning) at appropriate time, location and frequency

Advanced Tasks - Intermediate tasks plus

- 20.12 Conform with all legislation and Certificates of Approval during a spill or abnormal discharge



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